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92. INDUSTRIAL CHEMICALS AS WEAPONS OF MASS DESTRUCTION

Joe Hughart
Agency for Toxic Substances and Disease Registry
1600 Clifton Road, N.E., Atlanta, Georgia, USA, 30333

ABSTRACT

Industrial chemicals are used more frequently as weapons of mass destruction by terrorists than military chemical warfare agents. A database of incidents involving intentional releases of industrial chemicals was developed to determine those that should be addressed in training programs for agencies in the USA that have domestic or international emergency response missions involving hazardous substances. The database was developed from a variety of sources, including United Nations disaster databases, news media reports, and chemical industry databases of high production volume chemicals. An analysis of the frequency of incidents and potential hazards indicated that flammable gases such as liquified petroleum and natural gases posed the greatest hazard, followed in order of descending frequency and hazard by flammable liquids (e.g., gasoline), poison industrial gases (e.g., ammonia and chlorine), solid and liquid poisonous substances (e.g., pesticides), and radiation. Training programs were developed and conducted for several US military, public health, and public safety agencies based on these results.

INTRODUCTION

A number of countries participating in the Chemical and Biological Medical Treatment Symposia (CBMTS) are preparing to address the emerging threat of chemical terrorism. Preparations to address this threat have increased substantially in the United States since 1996. During this process, several lessons have been learned that may be of interest to other countries participating in CBMTS. In the USA, we learned to broaden our threat analyses to include common industrial chemicals, rather than focusing solely on improvised military chemical agents. We then learned not to focus only on extremely toxic and rare industrial chemicals; but also to consider common chemicals of lesser toxicity but greater accessibility. We learned to focus on all four major industrial chemical hazards (ignitability, corrosivity, toxicity, and reactivity) rather than on toxicity alone. Finally, we learned to review previous history and local conditions as part of the threat assessment and preparation processes.

In the first CBMTS industry conference, the author presented a 10-step method for identifying, mitigating, and responding to incidents of industrial chemical terrorism.[1] At the CBMTS conference held in Spiez in 1999, the author presented a database structure for training first responders on a broad range of hazardous chemical incidents.[2] The purpose of this paper is to present preliminary results from that training database focused on industrial chemicals that pose the most plausible threats from deliberate releases, such as those that may occur during incidents of terrorism, conflicts, and sabotage. More details about the topic may be found in the presentations from the CBMTS-Industry II Pre-Conference Workshop on Industrial Chemicals as Weapons of Mass Destruction. Finally, this paper describes current efforts by an international task force to further refine the list of chemicals that may pose hazards as a result of deliberate or collateral damage releases, and to develop a searchable database of assessment and assistance information for those chemicals. We hope to able to present the results of the international task force efforts at future CBMTS conferences.

METHODS

The structure for the hazardous substances database consisted of identifying critical factors for common types of hazardous substances emergencies, and incorporating those factors into three key words: DISASTER, ASSISTANCE, and ASSESSMENT. Each common type of incident had a worksheet in the database, and each worksheet listed critical factors whose first letter was one of the letters in a key word. This teaching technique is called mnemonics, and it is used to assist students in remembering key factors for various types of analyses. For the key word DISASTER, the factors to be considered for each type of incident were Dangerous times when the incident may occur, the type of Incident (e.g., bombing), Sites where incidents may occur, Acids and bases involved, Smoke and fire hazards, Toxic substances, Explosion hazards, and Reactivity hazards. For the key word ASSESSMENT, the factors were Amounts released, Sources of chemicals, Signs of a release, Environmental media or delivery methods involved, Sensitive populations, Syndromes, Morbidity and mortality in past incidents, Equipment currently available, Needs (population support needs, first responder needs, risk communication needs, etc.), and the Training level of the current responders. For the key word ASSISTANCE, the factors were Acute care, Sequellae and care, Supplies, Information, Safety and security issues, Training assistance available, Analyses (with emphasis on rapid field methods for identifying chemicals), Necessities for population support (e.g., food, water, and shelter), Communications resources (telephone hotlines, fact sheets to assist in risk communication), and appropriate Equipment assistance.

After developing the database structure, a two-phased approach was initiated to incorporate information into the database on industrial chemicals likely to be present in recurring types of incidents, such as accidents, natural disasters, conflicts, sabotage, and terrorism. In the first phase, which is the focus of this paper, historical information about major emergencies and disasters involving hazardous chemicals was incorporated into the database. The second phase will involve a more extensive analysis of dangerous high production volume chemicals around the world.

Historical information about disasters and other emergency incidents involving industrial chemicals was obtained from media reports, conferences (such as CBMTS-Industry I), existing databases (e.g., the United Nations Awareness and Preparedness for Emergencies at the Local Level, or APELL, chemical accident database)[3], chemical references, and published papers.

For the second phase, information about high production volume chemicals has been obtained from lists developed by the Organization for Economic Co-Operation and Development (OECD) in 1997[4] and the International Council of Chemical Associations in 2001[5]. These lists will be cross-referenced with U.S. National Fire Protection Association hazard markings to select those that are moderately to highly hazardous, and further cross-referenced with lists of producers in the Directory of World Chemical Producers, to select those chemicals that are potentially dangerous, produced in high volumes, and are produced in many locations. Worksheets will then be developed for those chemicals in the database.

RESULTS

One of the references used to develop the first phase of the database was a report prepared by the United Kingdom's Institute of Terrestrial Ecology, in which a number of international chemical accident databases were evaluated[6]. The Institute's report indicated that about 55% of the accidents occurred at fixed facilities, about 40% occurred as the result of chemical transportation (pipeline, rail, ship, and truck), and about 5% occurred during the transfer of chemicals from storage facilities to transporters, or vice versa. Only 3% of the

total number of accidents reviewed by the Institute were the result of deliberate releases (e.g., conflicts, sabotage, and terrorism). Most were the result of accidents, dumping, or defective containers.

The APELL database contains information for about 300 major chemical accidents that occurred between 1970 and 1998. About 15% of the accidents occurred with fuel gases (e.g., liquefied natural and petroleum gases, natural gas, and propane); about 8% respectively involved petrochemicals and liquid fuels (e.g., gasoline), and about 7% involved oil. Therefore, roughly the 38% of the accidents occurred with hydrocarbons (fuel gases, fuel liquids, oil, or refined petroleum products such as aromatic hydrocarbons).

About 15% of the accidents in the APELL database involved explosive industrial chemicals (e.g., black or smokeless powders, ammonium nitrate fertilizers, or dusts).

About 8% of the APELL database accidents involved chlorine, about 6% involved ammonia, and another 6% involved industrial acids and bases. Taken together, these corrosive substances account for 20% of the accidents listed.

Pesticides and chemical intermediates accounted for 3% of the accidents respectively.

The remaining 21% included polychlorinated biphenyls (PCBs, 2%), radiation sources (1%), unspecified chemicals (5%), and other types of chemicals (13%).

Recent news media reports and published chronologies of terrorist attacks indicate that industrial chemicals most frequently used or targeted by terrorists are the same groups of chemical described above; that is, they are the same groups of chemicals most frequently released as a result of all causes in the UN APELL database. This indicates that the industrial chemical database developed for training first responders on a broad range of emergencies may be used to conduct training on industrial chemical terrorism.

Hydrocarbons lead the list of industrial chemicals used as weapons by terrorists. Terrorists bombed oil pipelines in Colombia 73 times in 1998, 96 times in 1999, and 97 times in 2000[7-9]. Many of these attacks resulted in substantial casualties. In October 1998, 41 people were killed and 70 injured by a terrorist bombing attack on a Colombian pipeline. In December 1998, 73 people were killed when terrorists bombed British Petroleum's Ocensa oil pipeline, which set the village of Machuca on fire. The number of deaths in these incidents exceeded the number killed in the Aum Shinri Kyo nerve agent attack on the Tokyo subway system. The violence has spilled over into Ecuador, where a terrorist bombing attack on a pipeline in Sucumbios province killed 8 people in December 2000[10]. Oil exploration, production, and transportation is increasing in a number of locations around the world where terrorism is present, including Angola, the Caucusus, Chechnya, Gaza, Nigeria, and the Tri-border region of Argentina, Bolivia, and Paraguay. The U.S. Department of State reports that terrorist attacks on petroleum industry infrastructure in Nigeria are increasing[11]. INA petroleum production and distribution facilities in Croatia suffered damage as a result of deliberate attacks during the conflict with the Federal Republic of Yugoslavia[12]. Toxic substances in hydrocarbon smoke (in this case, carbon monoxide) caused ten injuries among firefighters responding to attacks on INA's Sisak refinery in October 1991. Therefore, analyses of industrial chemical terrorism must include hydrocarbon production, storage, transportation, and distribution facilities at the top of the list of potential targets.

The U.S. Department of State reports that, inspite of rhetoric by some terrorist groups advocating the use of military chemical agents, most terrorists continue to favor explosives, firearms, and abductions as their primary means of attack[11]. Industrial chemicals have been and will continue to be used as chemical intermediates by terrorists to fabricate explosives, as was the case in the World Trade Center, Oklahoma City, and Nairobi embassy bombings[13-15]. The explosive properties of industrial chemicals themselves may also be employed as weapons.

Attacks on chemical industries in Croatia during the conflict of 1991-1995 resulted in actual or potential releases of large amounts of ammonia, chlorine, inorganic acids, and organic acids in Zagreb, Kutina and Jovan[16,17.] Corrosive decomposition products in hydrocarbon smoke (nitric and sulfuric acids) were released during attacks on refineries such as Karlovac and Sisak. Therefore, corrosive industrial chemicals, and corrosive decomposition products in smoke from industrial chemical fires, must be considered in analyzing potential industrial chemical terrorism hazards.

Pesticides and chemical intermediates have also been targeted during deliberate release attempts. Attacks on Croatia's Herbos pesticide plant and Pliva's Pharmaceutical plant during the conflict of the 1990s had the potential to release large amounts of hazardous chemical intermediates into nearby populated areas in Sisak and Zagreb[17,18]. The release of methyl isocyanate at Bhopal in 1984 is now thought by some experts to have been the result of an act of industrial sabotage[19].

Other common chemicals that have been used in terrorist attacks include arsenic, cyanide compounds, mercury, phosgene, and thallium. With the exception of the Aum Shinri Kyo phosgene attack on a Yokohama rail sttaon, most of these attacks involved poisoning a limited number of individuals. One lesson to be learned form these attacks is that the inhalation and skin routes are not the only ones to consider when addressing industrial chemical terrorism: ingestion is an important pathway that has been used on several occasions.

Many of the attacks described above, particularly those targeting hydrocarbons plants and pipelines, were not motivated by attempts to release the industrial chemicals because they were highly toxic. Rather, the chemicals had strategic value during a conflict (in the case of Croatia, fuel production refineries), or they represented a political target (in the case of Colombia, the presence of foreign oil companies). Thus, chemical terrorism preparedness programs focused solely on assessing sources of extremely toxic chemicals may well miss the facilities and infrastructure most likely to be targeted by terrorists.

CONCLUSIONS

Industrial chemicals in the situations described above are not rare. extremely toxic substances. They are relatively common high production volume chemicals, present in most industrialized areas of the world. Therefore, they may be encountered in emergencies resulting from accidents as well as deliberate releases. First responders may use existing chemical safety references and databases to prepare for terrorism involving these chemicals. Many of these chemicals pose multiple hazards: ignitability, toxicity, corrosivity, and reactivity. All four hazards should be addressed when preparing assessments and identifying appropriate assistance measures to respond to deliberate releases. An in-depth analysis of hazards related to high production volume chemicals will be conducted as a second phase in the development of a hazardous substances database for first responders. The results of this second phase will be reported to participants in future CBMTS conferences.

REFERENCES

1. Hughart, Joseph L. (1999) Proc. CBMTS-Industry I, Zagreb, Croatia, 116-121.
2. Hughart, Joseph L. (2000) Proc. CBMTS III, Hazardous Substances Training for First Responders. Spiez, Switzerland.
3. United Nations. (2001) Awareness and Preparedness for Emergencies at the Local Level (APELL) Database. http://www.unepie.org/apell.
4. Organization for Economic Co-Operation and Development. (1997) List of High Production Volume Chemicals. OECD Environment Directorate, Paris, France.

5. International Council of Chemical Associations. (2000) High Production Volume Chemicals Working List. http://www.icca-chem.org/hpv.
6. United Kingdom Institute of Terrestrial Ecology. (1997) Environmental Follow-up of Industrial Accidents. London, UK.
7. St. Petersburg Times. (2000) Rebel Bombing Campaign Harms Colombia's Oil Industry. http://www.sptimes.com, Sep. 17th.
8. American University. (2001) Petroleum Mining and the U'Wa Indian Community. Trade and Environment Database, http://www.american.edu.
9. Global Exchange. (2001) Oil Rigged: There's Something Slippery About the U.S. Drug War in Colombia. http://globalexchange.org.
10. Stratfor.com. (2001) Tensions Spark Over Ecuadorian Oil Attacks. http://globalpolicy.org.
11. U.S. Department of State. (1999) Patterns of Global Terrorism. Washington, DC.
12. Billege, Ivan and Ivan Pavlenic. (1999). Proc. CBMTS-Industry I, Zagreb, Croatia, 46-48.
13. Nash. (1998). Terrorism in the 2oth Century. M. Evans and Co., New York, NY.
14. Dwyer, J. et. al. (1994). Two Seconds Under the World. Ballantine Books, New York, NY.
15. Kaplan, D. (1998). On Terrorism's Trail: How the FBI Unraveled the Africa Embassy Bombings. U.S. News and World Report, http://usnews.com, Nov. 23.
16. Friscic, Josip, et.al. (1999) Proc. CBMTS-Industry I, Zagreb, Croatia, 100-103.
17. Brebric, Zeljko and Ivan Peric. (1000) Proc. CBMTS-Industry I, Zagreb, Croatia, 50-56
18. Kobal, Darko, et.al.. (1999) Proc. CBMTS-Industry I, Zagreb, Croatia, 159-161.
19. Kalelkar, A. (1988) Investigation of Large Magnitude Studies: Bhopal as a Case Study, Arthur D. Little Co., Cambridge, MA.

KEYWORDS

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